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GUIDE  
TO  
PORTEUS MAZE TEST

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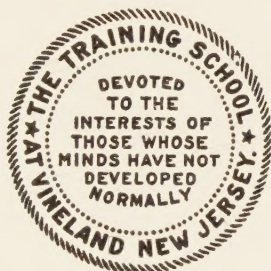


# GUIDE TO PORTEUS MAZE TEST

BY

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## CONTENTS

Chapter	Page
I GENERAL INTRODUCTION.....	1
II INTERPRETATION OF TEST RESULTS .....	5
III GENERAL INSTRUCTIONS . . . . .	20
IV DIRECTIONS FOR APPLICATION AND SCORING .....	24
V INVERTED AND ADULT TESTS.....	32



# **GUIDE TO PORTEUS MAZE TEST**

## **PART I**

### **GENERAL INTRODUCTION**

Among psychologists this is a day of changing attitudes as to the scope and importance of mental tests. For ten years the attention of workers in this field has been largely absorbed with tests of the Binet type. The history of this ten years makes decidedly interesting reading. The pendulum during that time has swung all the way from bitter and injudicious criticism of mental measurements to unqualified and unjustified acceptance. So many of the objections that were at first advanced against the Binet test were so ill-founded that their inevitable refutation helped to swing the pendulum in the direction of an over-confident belief in the extreme validity of the test results. So enthusiastic did the adoption of the Binet become that Binet test score and "mental age" became synonymous. Support was lent to this idea by the fact that some of the leaders of the mental testing movement published books and articles the titles of which would lead to the assumption that the measurement of intelligence and the application of a Binet test were one and the same thing. In all fairness it should be stated that careful perusal of the contents of these books would show that the authors did not hold strongly to the view that all that was necessary to discover the whole worth and potentialities of an individual was to find his Binet

I. Q. Indeed the very definition of intelligence approved by these writers was of wide enough scope to include many factors not evaluated by a Binet examination. Yet even though this was so, the practice of diagnosticians was in the majority of instances to impose implicit faith in a Binet score. To insist on the necessity of supplementing and correcting this verdict was to cry ineffectively in the wilderness. Even the efforts of those who believed in the importance of tests of the performance type were directed towards the task of finding, not correctives, but merely substitutes for a Binet examination.

The most unfortunate feature of the whole situation was that a greatly disproportionate amount of psychological effort was directed in the one limited direction. It is only since the war that the current of psychological thought has been diverted into other channels of endeavor. It is a pity that the realization that there were other worlds to conquer came so late, otherwise we might have at our command much more adequate tests for temperamental and character traits than we now possess.

It is not the intention of the writer to decry the good work that has been done in the last fifteen years. The Goddard and even more especially the Terman revisions of the Binet, stand out as marking high points in achievement. These represented notable and necessary advances but it was the general failure to look beyond these advances and to take the next step in research that is to be deplored. Happily, as was remarked in the beginning of this introduction, this attitude is changing. It is needless now to quote authorities to prove this for in a little while the opinion of the leaders will be the settled conviction of the rank and file.



The lesson of the paucity of our diagnostic aids in relation to the complexity of the problems of human measurement has been driven home as one of the results of the psychological examining during the great war. This new realization that there remains so much to be done in mental measurements is one of the by-products of that effort which is of inestimably greater benefit than the main object of that examining itself. The mere fact that the average mentality of the American nation could be stated in terms of a child's development is enough to prove conclusively that there are factors other than mentality worth measuring.

The writer's attitude towards the mental testing program in general has been made clear in a number of publications. With regard to the maze test particularly, a quotation from an early publication will make clear the writer's recognition of the need for supplementing Binet examinations for diagnostic purposes. "The mentally deficient person fails to adjust himself adequately to life's ordinary environment because he lacks foresight to anticipate, mental alertness to realize, and common prudence to deal with a situation . . . . . It is of course, not in the above directions only that the feeble-minded fall short. They may be feebly gifted in rote memory, number or color sense as well. The point is that we must not base our estimates of intelligence on these abilities alone, but must as far as possible, endeavor to test those larger capacities which count for so much in the individual's adjustment to the complexities of daily life.

There is, then, an urgent need for a series of tests which will put to the proof the capacities of prudence, forethought, mental alertness and power of sustained attention. Such a

series should be graded for the various ages, and would then form a valuable supplement to, and partial corrective of the Binet-Simon scale." (J. of Exper. Ped. June 1915)

During the years that have elapsed since the publication of this article a number of studies have been undertaken to validate this position. My first opinion, which with increasing experience has proved a mistaken one, was that the application of these tests is a comparatively simple matter. The conclusion has been borne in upon me that this is not so, and that slight deviations in procedure are important. Hence a set of directions should be issued that would cover all points of doubtful procedure. With the publication of these instructions the opportunity has also been taken to summarize as briefly as possible the facts regarding the nature, purpose and results of the test as we understand them today.

## PART II

### INTERPRETATION OF TEST RESULTS

#### **The Tests**

The Porteus maze tests consist of a series of mazes graded in difficulty and standardized for application to children from three to fourteen years of age. They were first described at a meeting of the British Association for the Advancement of Science in 1914, published in the *Journal of Psychoasthenics* and the *Journal of Experimental Pedagogy* (England) in June 1915. They were republished in revised form from Vineland in 1919.

#### **Purpose and Nature of the Tests**

The tests were designed to examine the individual's ability or his tendency to use planning capacity, prudence and mental alertness in a new situation of a concrete nature. Hence, though they are primarily tests of a form of mental ability, yet because impulsiveness, irresolution, suggestibility, nervousness and excitability interfere most with the subject's success, they are to be regarded as being in large part, tests of temperamental capacities as well. It is this which gives the maze test a peculiar value. Maze-threading as such may not have a particularly close connection with every-day planning capacity but habits of prudence and preconsideration in emergency are absolutely fundamental to social adaptability. In other

words the choice of the maze for test material is of little significance compared with the procedure that has been laid down for the application and scoring of the tests. It is only when the test is applied as arranged by the author that prudence and preconsideration are given their proper weight. Lack of understanding with regard to this essential point has resulted in the comparative failure of other attempts to use the maze as test material. For example, results from the mazes used in the Army Beta Scale have little more value or meaning than those from a host of other performance tests.

### **Maze Test Procedure**

The conditions of application of the maze tests are such that the subject in every case is given an opportunity to realize his own errors and by a system of repeated trials to profit by his experience and to re-adapt his methods. This latter characteristic is the most important feature in the Porteus maze tests and one that is lacking in most performance tests, especially those of the puzzle solving variety where trial and error methods are allowed without penalty in the scoring.

### **Time and Errors in Scoring**

It is not sufficiently recognized that a maze test in which no account of errors is taken or one which is scored with a time limit is not, properly speaking, a test of temperamental qualities at all. When errors are not taken as the basis of the scoring it ceases to be a test of prudence in behavior but merely of a special kind of mental alertness. This is true not only of the maze test but of any test in which false moves are allowed. It is obvious that the impulsive person who rushes

into error but has sufficient mental alertness to retrieve himself quickly suffers hardly any handicap in time of performance at all. He sees no necessity therefore to modify his method of attacking the task. In a maze test of the "slot" variety where the task set the child is to pass an object through a slotted maze in the quickest possible time, it is evident that little, if any, distinction is made between a child who makes a number of impulsive errors but corrects them quickly and one who by prudent preconsideration avoids all errors. The one child is mentally alert but imprudent, the other puts caution above speed. In the Porteus maze test immediately an error is made the subject is stopped and the test must be begun over again. The need for more prudent action is thus made apparent. It is impossible to evaluate, at the one time, speed of decision and prudent preconsideration. The one precludes the other. For tests of this nature the attempt to combine speed and errors in the one scoring combination seems to be wasted ingenuity.

### **Comparative Values of Tests**

As far as mental diagnosis is concerned the value of a test score is in predicting how well a person will adjust himself to his social environment. It is necessary for the clinical psychologist therefore to select tests which have the most direct relation to socially valuable qualities. Surely the estimation of a tendency to careful and prudent preconsideration is more worthwhile because of its relation to everyday efficiency than the measurement of the ability to match geometrical forms quickly or to build up intricate patterns with colored blocks or to thread speedily through a "slot" maze.

Undoubtedly all these have value as tests of certain mental abilities, but we already have scores of tests, all nearly equal in value, for testing these abilities. Fundamentally these tests do not differ from the Binet, except that because of the narrow range of their test material they depend more closely on the theory of a general intelligence which can be equally well tapped and measured at any point and with a small sampling. But of tests which aim specifically at showing up the temperamental defects which interfere with mental ability and thus mar achievement, we have pitifully few. The Porteus maze test, because of the conditions of its scoring and application, is one of the outstanding few. It is ridiculous, of course, to suppose that it tests all temperamental traits. There are important temperamental characteristics that it leaves untouched. The author has not presumed to formulate any theory of "general temperament" to match the theory of "general intelligence." The contention is made, however, that if a subject tests distinctly below the normal level of performance in this test, he possesses a temperamental inadequacy in certain important directions which is a very serious bar to his social adjustment. If he is also subnormal mentally, then his chances of social sufficiency are extremely meagre.

### **Standardization**

The tests were tentatively standardized in 1914 and were applied to 1000 unselected school children. Modifications, chiefly in scoring, were made and the tests were applied to another group of 1255 children. The present scoring was then adopted. Burt has tested this standardization with London children from six to fourteen years of age and found that



their average mental ages were, except at one age level, within a fraction of a year of their chronological age. It should be pointed out that the tests were standardized as a series rather than by determining the difficulty of each individual test. Certain modifications of the scoring have now been made in order to allow subjects to attain a maximum score of sixteen years in the tests.

### **Application**

The tests have been applied to a number of abnormal groups of children including feeble-minded, the deaf and dumb, and to delinquents. They have also been applied to different racial groups including Portuguese, Hawaiians, Chinese, Japanese, and Australian aborigines and the results reported in various publications.

### **Validity of Tests**

The relation of maze test results to social sufficiency has been proved by many investigations. The correlations that have been obtained in these studies vary somewhat according to the age and mental level of the subjects. As a general rule the nearer the subject approaches moron levels the greater the diagnostic value of the maze tests. It is therefore of most assistance where diagnosis is most difficult—another point of difference from most performance tests.

Nine separate studies have been made to discover the relation of social capacity to Porteus maze score and in each, for comparative purposes, the correlation of the Binet with social capacity has also been found. In each study the estimates or ratings of social capacity were given by independent

judges who had observed the cases rated for periods of from five to twenty years. Three of these studies were made by the writer, five by Miss Babcock and one by Miss Dewey. With males the average correlation of the Porteus maze test with social capacity was, for all the studies, .68. The average correlation of the Binet with the social ratings was .64. In four other studies with females the average correlation of the maze with social adaptability was .76; of the Binet .69. As a measure of social adaptability at or about moron levels the maze test is therefore somewhat superior to the Binet, its advantage being more marked with females.

Correlation of maze scores with ratings of single temperamental traits showed that the relation of the maze test score to suggestibility, irresolution, lack of planning capacity and impulsiveness was closer in the case of females than males. As these traits would naturally have more weight in an estimate of social sufficiency in females, this would probably account for the difference in the correlation with the two sexes.

### **Combining Binet and Porteus Ages**

At first sight it might appear that the correlations for the two series of tests being close together would indicate that either test might be used with equal advantage. But the fact that the coefficients are only of the order .6 or .7 shows that there are some cases in which there may be a wide difference between the individual's test score and his social rating. No mental test is infallible. A test score represents only a sample reaction or a cross section of the individual's behavior. Unfortunately the sample may be too small or the cross-section not at the right level so that traits of character essential to

success are not given their proper weight in the test. The value of the maze test lies in the fact that children who are often under-rated by the Binet score well in the maze. Conversely, children often over-rated by the Binet, make inferior scores in the maze.

As social sufficiency is dependent on mentality plus temperament it is recommended that for diagnostic purposes the Binet and Porteus test age should be averaged. An average I. Q. of below 75 is symptomatic of social inadequacy. The value of the combination of test ages may be gauged from the correlations. In six studies the average Binet-Porteus correlation with estimates or ratings of social adaptability was .73 for males and .80 for females. This is significantly higher than for either test taken singly. The fact that the Binet correlates as low as .5 to .6 with the Porteus maze is an additional reason why they should be combined in a test battery.

If the psychologist is looking for a test which he can substitute for the Binet, then a test with a high correlation—say .80 or above—should be chosen. Of these there is quite a number, but to my mind none of them is as satisfactory as the Binet. In other words they all plough over the same ground but not so deeply as the Binet. But if a truly supplementary test be required—viz. one that will be a corrective to a Binet score, then a low correlation is a positive advantage, provided always that the test correlates highly with social adaptability. Clinical psychologists generally have now come to the opinion that the Binet is not adequate as a diagnostic test and that it requires supplementing. It is verbal intelligence that the Binet, in large part, measures and as Rugg wisely remarks—"It has been clear for some time that we need

to recognize that verbal intelligence represents only one-fifth or one-sixth or one-eighth of human personality."<sup>1</sup> The maze test is an attempt to evaluate some of those character traits which, given a certain basic level of mentality, are of such supreme social importance.

### **Reliability of Tests**

It is of course, obvious that a test which is unreliable, that is to say whose results with the same subjects vary so that they test high on one application and low on the next, or vice versa, is not to be depended upon. A distinction should be made, however, between such tests and those in which results vary only in the one direction, that of improvement in score. It is plain that the variation is not in the latter case due to any inherent unreliability of the test but to practice effects.

This is the case with the Porteus maze test. In addition it must be remembered that the procedure of allowing repeated trials as well as of allowing each subject to start at the lowest tests and to work through the whole series is deliberately arranged in order to observe the individual's ability to profit by his experience. That individuals differ in this respect is only to be expected. Consequently on a second application of the test some individuals will improve considerably on their first score whilst others will not improve at all. Under such circumstances, to use the ordinary coefficient as a test of reliability is to grossly mis-apply statistical methods. A valuable feature of the test lies in the fact that it presents on its first application to the child a new situation. This is shown by

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1. *Journal of Educational Psychology* Jan. 1924 Page 60

the fact that so many individuals improve their score so much on a second trial when the situation is no longer new. When practice effects are allowed for, the maze is one of the most reliable that we have. Morgenthau,<sup>1</sup> in a study of 112 normal children, using a number of tests, found the reliability of the maze to be .95. This is fully as high as the coefficient for the Binet which was found by Terman to be .93.

The fact that practice effects are so apparent in the maze test affects the second application of the test. Another system of scoring is recommended if a second application is desirable. For diagnostic purposes it should be rarely necessary to require a second application.

### **Relation to Race**

In a monograph (shortly ready for publication) it will be shown that significant racial differences in temperament may be demonstrated by the application of the maze tests to racial groups. These are as permanent, apparently as the physical characteristics of race. For instance, Japanese boys were found to be superior to Chinese boys at every age from nine to fourteen years. Similarly Japanese girls are superior at every age to groups of Chinese girls. Both Japanese and Chinese boys are markedly superior to Portuguese. American boys are below the Japanese at each age up to twelve years from which point they have the advantage. Apparently therefore, the tests bring to light most important temperamental differences due to race. Racial history may well be affected by these differences. Because of the relation of glandular activities on the one hand to physical differences, and on the other

1. Some well known Tests Evaluated and Compared. Archives of Psychology No. 52 May 1922.

to temperamental characteristics, it opens up a most interesting field for speculation as to the origin and nature of racial distinctions.

### Relation to Sex

Similarly differences in temperament in the sexes are also brought to light by the maze tests. In two studies involving large numbers of cases boys were superior to girls at every age from six to twelve years of age. At twelve years of age, however, girls had the advantage. Working with an extension of the tests<sup>1</sup> it was found that amongst High School students from fourteen years onwards, males were superior to females both in time and accuracy. With other nationalities the same superiority of males was evident. Japanese and Chinese boys had better average scores than girls at each age from nine to fourteen years. These differences cannot be accounted for on the score of the boy's greater familiarity with the type of situation presented by the tests, though this would account for the superiority of males in many other performance tests. The maze situation is quite new to both sexes. Hence the differences in performance are most probably due to differences in temperament.

It is not only the constancy of the differences but the amount also that is significant. The disparity between the scores of Chinese boys and girls is greater than that between Japanese boys and girls, and this despite the fact that the Chinese boys tested relatively so low. The average superiority in boys for six different age groups was for the Chinese  $\frac{.70}{.6}$  and Japanese  $\frac{.06}{.75}$  of a year of mental age. With children

1. Sex Differences in Porteus Maze Test Performance By Dorothy M. Bassett and S. D. Porteus Research Publication No. 22 Dec. 1920.



of Anglo-Saxon origin the superiority is not nearly so marked. The average superiority in boys' performance is only .35 of a year for seven different age groups, whilst the girls at twelve years are actually superior.

### Uses of Tests

The main value of the Porteus maze tests lies, of course, in their use as diagnostic measures. Combined with a Binet examination they make diagnosis much more certain. Because of the work that has been done with regard to the interpretation of maze test results in terms of social adaptability, it pays the clinical psychologist to use them rather than any scale of performance tests, the value or validity of the units of which has never been proved. The day is surely passing when the psychologist will be content with the procedure of using a conglomeration of tests without any psychological analysis of their value—analysis founded, of course, on statistical treatment—and in which no attempt at weighting the various tests is made. The term "scale" applied to such a haphazard grouping of tests, whether performance or otherwise, is certainly a misnomer. It has not yet apparently dawned on the minds of certain psychologists that the diagnostic value of a test is not its comparative difficulty, or the correctness of its standardization but the actual relation of the test to the social criterion.\* A performance test such as the

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\*It is evident from this criticism that we do not believe in the feasibility of a "percentage definition" of feeble-mindedness. Pintner and Paterson and Miner have proposed that all cases falling below a certain standard in intelligence tests should be considered feeble-minded and all those falling below a certain standard in character and temperamental scales be considered psychopathic. As Pintner admits, (*Intelligence Testing* p. 182) the definition has no social implications and a definition without social implications would serve no practical

Knox Cube test can be graded in difficulty and standardized, but the social value of the abilities tested is absolutely uncertain. No adequate proof has ever been presented to show that the ability to attain a good score on the Knox Cube test is any index of ability that is of every-day value to the individual.

This objection cannot be advanced against the maze test. It has been proved that a high maze score has a fairly close relation to industrial ability. For males the Porteus test age was found to correlate .67 with industrial ability as against .62 for the Binet and .61 for a selection of the most reliable performance tests of the Army Beta Scale. For females the maze test correlated .75 as against .66 for the Binet and .63 for the army tests. In four other investigations where mental tests were correlated with ratings on an industrial rating scale, the average coefficient for the Binet was .69; for the Porteus .80 and for the Binet-Porteus average .84. These results are confirmed by a study by Miss Ross in Scotland who found a correlation of .76 for Porteus with Handwork as against .69 for Binet.

### Limitations of Tests

Despite their high correlations with social adaptability the maze test scores do not detect all cases of mental instability. Though as a general rule mal-adjusted individuals do not score well in the maze, there is a type of psychopathic individual

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purpose. The most telling objection to the proposal is that there are many individuals who would fall by the percentage definition in neither category but whose social inadequacy is due to a combination of mental and temperamental defects in development. It would be better to continue to apply the term "feeble-minded" to these and to use "psychopathic" to describe those with peculiarities of conduct indicative of the lesser degrees of mental disease.

whose test score is not a reliable index of his social potentialities. These are cases who are usually egocentric but mentally alert. There is also a type of delinquent child who is physically active and has quick perceptions and who shows up well in a short supervised task of a novel nature such as the maze, but who does not carry satisfactorily the more tedious, long continued responsibilities of every-day life. Because of the success of these cases in the maze the writer has been careful to state that failure in the tests is more significant than success. In other words some anti-social temperaments escape the mesh.

In addition to these cases over-estimated by the tests, the steady-going dependable defective with good practical ability will frequently score too high. Such cases if given their own time will adjust themselves successfully under training, but the conditions of every-day industry do not allow for their slow response. In such cases, however, their Binet score is relatively too low so that the average Binet-Porteus age is a very good index of their adaptability.

### **General Summary**

The maze test practically stands alone in its application to certain important temperamental characteristics. Its value is gained, not so much by the choice of the maze as test material, but by the conditions that have been laid down for its scoring and application. The procedure is such that the greatest weight and emphasis are attached to the subject's tendency to use prudence and to profit by his mistakes. It is this feature of the tests which warrants their use as tests of temperamental capacities. Otherwise it would be true that

the type of behavior tested—i. e. maze threading—is too limited in the range of the responses it calls forth to be of service as an index of every-day efficiency. The habit of prudent preconsideration is, however, of such generalized value as to bring the test into wide relations to many of the activities of every-day life.

There are other excellent tests and scales of performance tests but these have a different purpose and value. They are, in the main, substitutes for a Binet examination. Even when these are used, they need supplementing by a test of temperamental capacities because in every case, social sufficiency is dependent upon mentality plus temperament.

The value of combining the Porteus maze scale with the Binet scale is shown by the correlations of each with ratings of social adaptability. No other test has had such an amount of investigation expended on it to further its diagnostic interpretation. For purposes of practical classification it is most useful as is shown by its high correlations with industrial capacity. It also brings to light important temperamental differences due to sex and race. When practice effects are allowed for, it is one of the most reliable tests in use. Its chief limitations lie in the fact that, as may be expected, it does not test all temperamental defects so that certain types of mal-adjusted individuals score too highly. It cannot be safely re-applied to the same children without proper allowance for practice effects. The procedure for a second application is described in the general instructions.

### **Reasons for Clinical Use**

1. The scale has been in use for nine years and has

stood the test of time and experience. It was the first age scale using different material from the Binet to be presented in this country.

2. It is easy to give, provided the examiner uses ordinary psychological insight as to its nature and purposes.

3. It is not dependent on language.

4. It takes but a relatively short time to apply. On the average about fifteen minutes per child is sufficient.

5. It consists of a scale using the same kind of test material throughout the series. This admits of ready interpretation. There is no objection to combining heterogeneous tests into a scale, provided the necessary work has been done with regard to proving the relative value or validity of the units of the scale. This has never been done with any scale that we know of—the selection of tests necessarily being arbitrary until their diagnostic value has been proved.

6. It is the only readily applicable graded scale that permits an evaluation of some temperamental traits most important to every-day adjustment. It is not a “general intelligence” scale and is intended not to supplant but to supplement such scales.

7. With the exception of the Binet no test scale has been so widely used. Results from its application to delinquents, deaf and dumb, feeble-minded, psychopathic, hookworm cases, normal children of all grades from kindergarten to high school, and various racial groups have been reported.

8. No test scale has had so much work expended on its clinical interpretation as the maze. It is not a perfect instrument of research but because it stands almost alone in its field it must suffice until a better one is devised.

## PART III

### GENERAL INSTRUCTIONS

#### **Beginning the Test**

1. Never begin testing above the five year level of the scale, no matter what the age of the child. This is to ensure that a certain amount of practice will be given the child by allowing it to work through the easier tests of the series. This gives the individual an opportunity to familiarize himself with the type of situation involved. On account of this procedure the gradation in difficulty of the tests has been made relatively greater at the upper end of the scale.

#### **Limits of Testing**

2. Continue the testing until failure in the tests for two successive years has resulted.

#### **Self-correction of Errors**

3. Do not allow the child to correct his own error by retracing his course. He should be stopped almost immediately an error is committed and be given a new sheet and the test recommenced. The examiner should say, "You cannot get out that way. Begin again here." An error consists in crossing an imaginary line across the opening to a passage leading to a blocked place. Bringing the child back to the starting point after an error is intended to impress the child with the



seriousness of making a mistake. However, no explicit warning as to the need for care should be given. This procedure also is to safeguard against accidental success up to the point where the previous error had been made.

### **Number of Trials**

4. Never allow a child more trials than the instructions provide for. Some examiners have allowed the child to continue with additional trials of a test after the number allotted in the instructions have been given. Obviously this is providing practice which may affect the child's success in the ensuing tests and is a serious error in technique.

### **Tracing the Course in the Air**

5. Never allow the child to trace the course in the air with the pencil or finger. This is equivalent to preliminary practice. If the child persists in doing this after being warned, he should be told to keep his hands by his sides until he is ready to begin the test.

### **Use of Test Blanks**

6. It is inadvisable to use the same test blank for more than one trial. Occasionally in the twelve and fourteen year tests if a mistake is made near the beginning, it is possible to erase the pencilled record without leaving any mark. The blank may then be used a second time. Using a pointer is admissible but is not as satisfactory as using a pencil. Small errors are sometimes overlooked when no actual record is available for inspection.

**Penalizing all Errors**

7. Never allow an error to go unpenalized, no matter how slight or how quickly corrected it may be, unless it is very obviously a slip of the pencil due to poor motor control. Many quick witted but impulsive children make slight errors and retrieve them immediately. These errors should of course be rigorously penalized. Careful observation is necessary to distinguish such an error from a "slip of the pencil." In doubtful cases, invert the test.

**Giving Directions**

8. As maze threading is, for all children tested, a new task, it is most necessary that the directions for years V and VI and XI be given carefully and completely. For foreign or deaf children it is necessary to use the five and sometimes the six year test as demonstration forms. The purpose of the test is not to test the verbal comprehension of the child but to discover his ability to adapt himself to the actual maze situation.

**Position of Examiner**

9. The examiner should sit facing the child and should hold the test blank with the tips of the fingers squarely in front of the child. Care should be taken not to present the test upside down unless it is to be inverted according to instructions.

**Crossing Lines**

10. In tracing the correct course around a maze, the child may, through inadvertence, run across a line. Except in

the three and four year tests this is not penalized, although the child should be told to keep between the lines. He should also be warned against lifting the pencil from the paper after the trial is begun. No penalty is attached if the child lifts his pencil; the warning however should be repeated as often as is necessary.

### **When to Invert a Test: Scoring**

II. When a child fails in a test but succeeds in the next higher test, the latter should be turned upside down and the test repeated, giving of course the allotted number of trials. This procedure is not always necessary in the lower tests of the series but should always be followed above the nine year level. In the simpler tests the examiner may often judge whether success is accidental or not but in the higher tests this is much more difficult. It should be remembered that whilst **success in the maze may be accidental, failure never is.** The scoring adopted when tests are inverted is based on the worse record of the two applications. In other words the penalty for error is imposed whether incurred in either the original or inverted trial, but not on both. Thus a child who succeeded in the eleven year test on the first trial but took two trials on the inverted eleven year test will receive only half credit. Similarly half credit only is given if two trials were taken in the original and one trial in the inverted.

## PART IV

### DIRECTIONS FOR APPLICATION AND SCORING

#### TEST FOR YEAR III

Examiner says, **“Look, here are two black lines on this paper. I want you to take this pencil and draw around between the black lines as carefully as you can without touching them, like this.** (Examiner illustrates by drawing about an inch along the path starting from S and in the direction of the arrow). **Be sure to keep the pencil right between the lines.”** (If necessary, the examiner may hold the child’s hand and guide the pencil down to the first turn in the path.)

For non-English speaking children, the test may be used for demonstration purposes, the child doing the test after the examiner has demonstrated it on another test blank.

Two trials are allowed and III-year credit is given if on either trial there are not more than three errors in running off the path. Any attempt, however crude, at following the outline of the test is indicative of ability at about a two year level.

#### TEST FOR YEAR IV

Examiner says, **“Do this just the same way. Start here.** (Indicate S) **Draw right around between the lines. Be sure and don’t cross any.”** (As in the previous test the examiner may indicate the way in which the pencil is to move.)

Two trials are allowed, IV-year credit is given if on either trial there are not more than two errors in crossing the lines.

### TEST FOR YEAR V

The instructions for the V year test should be given verbatim as follows. **“These are all roads and the lines are fences. Some of the roads are open and some are closed. This road is open and if you were driving an automobile you could get out here.** (Point to the opening at the end of the fourth road and indicate without touching the paper the motion of passing out through the open space.) **This road is open and you could get out here.** (Point to opening at the end of the sixth road and again indicate motion of passing out through the open space.) **But there is a fence here.** (Point to seventh road and show line across the end.) **You couldn’t get out here. And there is a fence here, here, here, and here, so you couldn’t get out.** (As the above directions are given, point to the line blocking the exit in the fifth, third, second and first roads in order, showing that the child cannot get out the blocked place.) **Now take the pencil and start here.** (Indicate S) **Go down the road and go out the first open road you come to.”**

If the child succeeds on the first trial, continue with the VI year test. If the child fails by going into a blocked road or going out the sixth road, the instructions are repeated verbatim and a second trial on a new blank is allowed.

There are six possibilities which determine the credit for this test.

1. The child goes out the first open road (fourth road) on the first trial. Full credit, one year.

2. The child goes out the second open road (sixth road) the first trial, and on the second trial goes out the correct opening. Full credit, one year.

3. The child goes out the second open road both trials. Half credit.

4. The child goes into a blocked road the first trial and goes out the correct opening the second trial. Half credit.

5. The child goes into a blocked road the first trial and goes out the second opening the second trial. No credit. (The general instructions state that the testing proceeds until there have been two successive failures, but in this case, while no credit is allowed, the test is not counted as a failure in the above sense.)

6. The child goes into a blocked road both trials. Failure.

No more than two trials are allowed for the test.

## TEST FOR YEAR VI

Examiner says, **"Start here** (indicating S) **and find your way out here.** (Point out arrow at the other end.) **You may go along any road you like but you must not go into any blocked roads nor cross any of the lines. Start here** (indicating S) **and find your way out here.** (Point to final arrow.) **You may stop and look as long as you like but you must keep your pencil on the paper."**

Allow two trials. If the child immediately cuts across a line he should be stopped and the injunction against crossing lines emphasized. The instructions are repeated verbatim and a second trial given.



### TEST FOR YEAR VII

Examiner says, **“Start here** (pointing to S) **and find your way out just the same way without going into any blocked places and without crossing any lines.”**

Allow two trials.

### TESTS FOR YEARS VIII-IX-X-XI

Examiner says, **“Start here and find your way out the open place.”** (Indicate S for the start but do not show the exit.) In any of these tests the child may hesitate, point to the exit and say, “Is this the open place?” The examiner should reply, “You must find the open place for yourself.”

Allow two trials for each test.

### TESTS FOR YEARS XII-XIV

Procedure as before. **“Start here** (indicating S) **and come out the open place.”**

Allow four trials for each test.

## SCORING

1. Assuming that the child has received full credit for the three and four year tests in accordance with the instructions previously given, allow a basal test age of four years. To this add one year for every test passed on the first trial up to and including the eleven year test. Add a half year for each of the tests passed on the second trial. No credit is allowed if the test is failed on the second trial.

2. If both the XII and XIV year tests are passed, add together the number of trials taken in both tests and give additional credit as follows:—

Sum of trials in XII and XIV years	Credit to be added to score already obtained in lower tests.
2 trials	5 years
3 trials	4 years
4 trials	3 years
5 trials	2½ years
6 trials	2 years
7 trials	1½ years
8 trials	1 year

3. If the XIV year test is failed, credit one year if the XII year test is passed on the first, second or third trial. Credit one-half year if the XII year test is passed on the fourth trial.

4. If the XII year test is failed and the XIV year test is passed, credit is given as follows:—

No. of trials in XIV year	Credit to be added to score already obtained
1 trial	2 years
2 trials	1½ years
3 trials	1 year
4 trials	½ year

In this case the XIV year test should always be inverted. (See General Instructions No. 11)

By the above method of scoring the highest test age obtainable in the maze series is 16 years. This is given if every test is passed on the first trial.

## DIRECTIONS FOR APPLICATION AND SCORING 29

If the adult tests are used, additional credit is obtainable as follows:—

No. of trials in adult tests	Credit to be added to score already obtained
2 trials	2 years
3 trials	1½ years
4 trials	1 year

The total score obtainable in the series if the adult mazes are used is 18 years.

### EXAMPLES OF SCORING

Example 1.

Test	No. of trials	Credit
5 yr.	2nd opening each trial	4½ yrs.
6 yr.	1 trial	1 yr.
7 yr.	2 trials	½ yr.
8 yr.	F	0
9 yr.	1	
Inverted 9 yr.	2	½ yr.
10 yr.	1	1 yr.
11 yr.	1	1 yr.
12 yr.	3	1½ yrs.
14 yr.	4	

} 7 trials

---

Test Age 10 yrs.

Note: In the 9 year test the score in the inverted test is taken as it is the worse of the two records.

## Example 2.

Test	No. of Trials	Credit
5 yr.	2nd opening 1st trial 1st opening 2nd trial	5 yrs.
6 yr.	1 trial	1 yr.
7 yr.	1 trial	1 yr.
8 yr.	1 trial	1 yr.
9 yr.	2 trials	$\frac{1}{2}$ yr.
10 yr.	2 trials	$\frac{1}{2}$ yr.
11 yr.	F	0
12 yr.	4	$\frac{1}{2}$ yr.
Inverted 12 yr.	1	
14 yr.	F	0

---

Test Age  $9\frac{1}{2}$  yrs.

Note: In the 12 year test the original score is taken as it is the worse of the two records.

## Example 3.

Test	No. of trials	Credit
5 yr.	1 trial	5 yrs.
6 yr.	1 trial	1 yr.
7 yr.	1 trial	1 yr.
8 yr.	2 trials	$\frac{1}{2}$ yr.
9 yr.	1 trial	1 yr.
10 yr.	F	0
11 yr.	2	0
Inverted 11 yr.	F	

---

Test Age  $8\frac{1}{2}$  yrs.

Note: No credit is given for 11 year success because of failure when test was inverted.

# DIRECTIONS FOR APPLICATION AND SCORING 31

## Example 4.

Test	No. of trials	Credit
5 yr.	1 trial	5 yrs.
6 yr.	1 trial	1 yr.
7 yr.	1 trial	1 yr.
8 yr.	1 trial	1 yr.
9 yr.	1 trial	1 yr.
10 yr.	2 trials	$\frac{1}{2}$ yr.
11 yr.	1 trial	1 yr.
12 yr.	2	$2\frac{1}{2}$ yrs.
14 yr.	3	
} 5 trials		
Adult 1	1 trial	$1\frac{1}{2}$ yrs.
Adult 2	2 trials	
} 3 trials		

---

Test Age  $14\frac{1}{2}$  yrs.

## PART V

### INVERTED TESTS

#### Procedure for Second Application

It has already been explained that practice effects are apparent on a second application of the maze tests. Because of the procedure of allowing repeated trials, the child becomes more or less familiar with the maze situation. Provided he has the capacity of profiting by experience he has evolved in working through the series a method of attack. When the maze tests are applied a second time the situation is no longer new, even though he may have forgotten the actual form of the mazes. In order to obtain approximately uniform results to those obtained on the first testing, a different procedure and a much severer scoring must be adopted in the second application. The tests are inverted throughout and one trial only allowed up to and including eleven years. Three trials are allowed in both the XII and XIV year tests. In scoring, one year is deducted for each failure. As in the original application the trials taken in the twelve and fourteen year tests are added together and credit is given as follows:—

6 trials — 1 year  
5 trials — 2 years  
4 trials — 3 years  
3 trials — 4 years  
2 trials — 5 years

To be added to credit  
obtained in tests below  
the XII year test.



In the event of a child failing in the fourteen year test a half year's credit is given if the twelve year test is passed on the third trial; one year's credit if passed on the first or second trial. Similar credit is allowed if the child fails on the twelve year test and succeeds on the fourteen year test.

### **Significance of Inverted Tests**

The inverted test has a somewhat altered significance to the original maze. It correlates about .80 with the first application. With a group of thirty cases the first score correlated .75 with the Social Rating Scale and the inverted correlated .70 with the same scale. The average of the scores in the first and second applications of the test correlated .77 with the Social Rating Scale. If for any reason the child is to be re-examined by the maze test, the procedure in scoring as outlined above is recommended. If the examiner feels that chance has materially affected the child's success on the first application of the test the series should be inverted and scored as above and the average of the two tests taken. This procedure is especially recommended for children who show psychopathic tendencies.

## **THE ADULT TESTS**

Two new tests have been added to the original series in the hope that a test of ability at higher age levels could be found. These tests were applied by Miss Bassett and the writer to groups of high school students ranging in age from

thirteen to nineteen years. In giving the instructions for these tests the emphasis was not placed on speed but as the subjects knew that their time was being taken with the stopwatch, speed entered into the test as a rather important factor. The XII and XIV year tests of the original series were given first as practice.

## Results

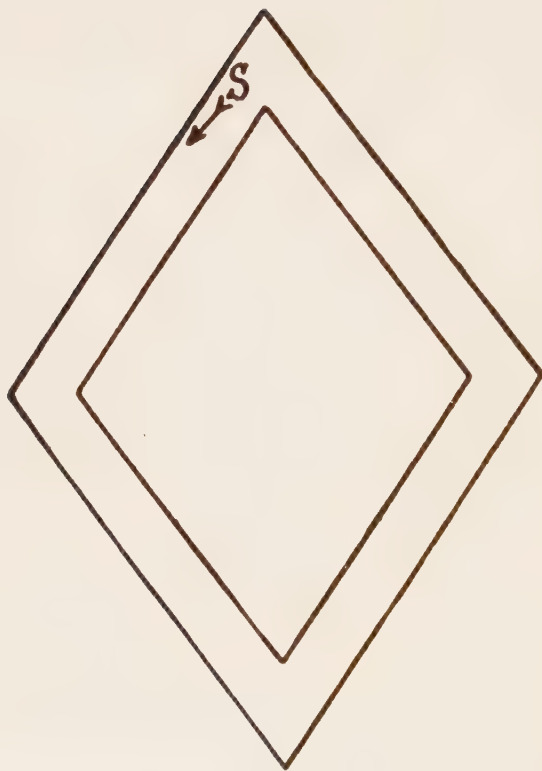
As regards sex performance, males were superior in average number of trials in test Adult I at 13, 15, 16, 17, 18, and 19 year levels, females being superior at 14 years. In test Adult II, males were again superior to females in accuracy at six age levels, girls having the advantage at 15 years. In speed of performance, males were superior in both of the adult tests at every age level. We can therefore conclude that in the traits tested by the adult mazes males are superior.

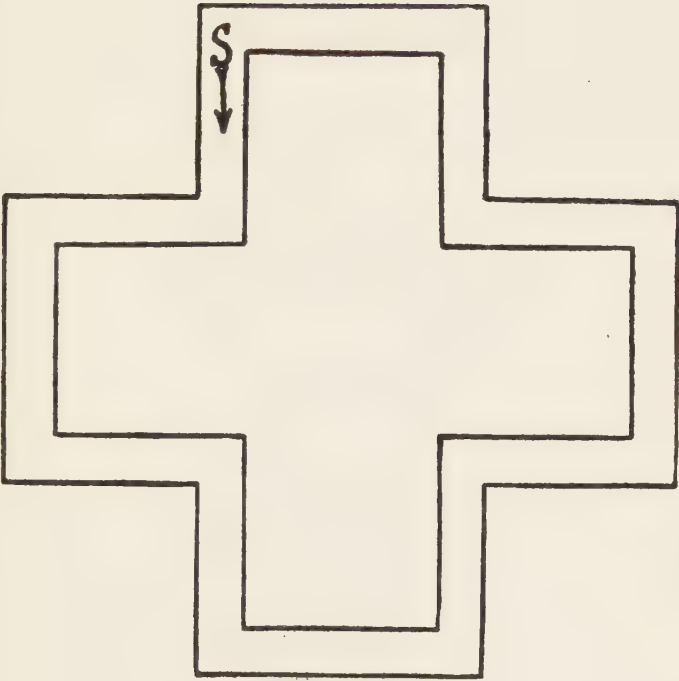
Grouping the cases together in two-year age periods, improvement with age can be shown both as regards speed and accuracy. The 18-19 year group score better on the average than the 16-17 year group and the latter had the advantage over the 14-15 year group. Grouping the cases by single years, there are some fluctuations as regards improvement in average performance. Despite these, we may conclude that there is a general tendency for accuracy and speed of performance to increase with age. If speed were disregarded altogether in the application of the tests, I believe that the increase of accuracy with chronological age would be more marked. Dr. Wakeman, using the tests in Cornell University, found a marked improvement in the score of cases twenty-one years and over, as compared with cases grouped in three-year age

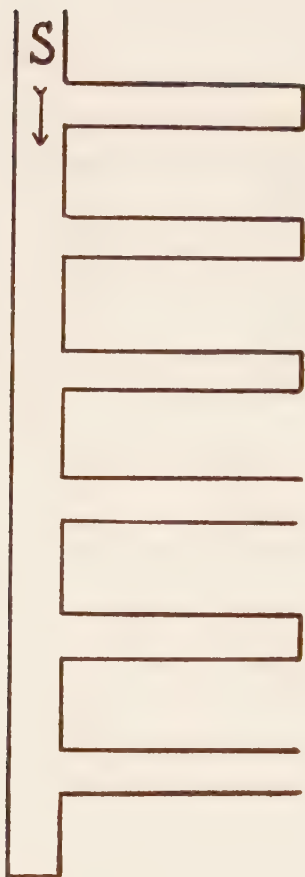
periods below that level. There is evidence therefore, that development in the traits covered by the adult mazes that development does proceed up to adult levels.

It is recommended that in applying the adult mazes, time of performance should be neglected in the scoring. A time limit of five minutes should be imposed but no reference to this time limit should be made in the instructions. As has been previously emphasized, to impress the subject with the idea that he is working against time is to alter the character of the test entirely.

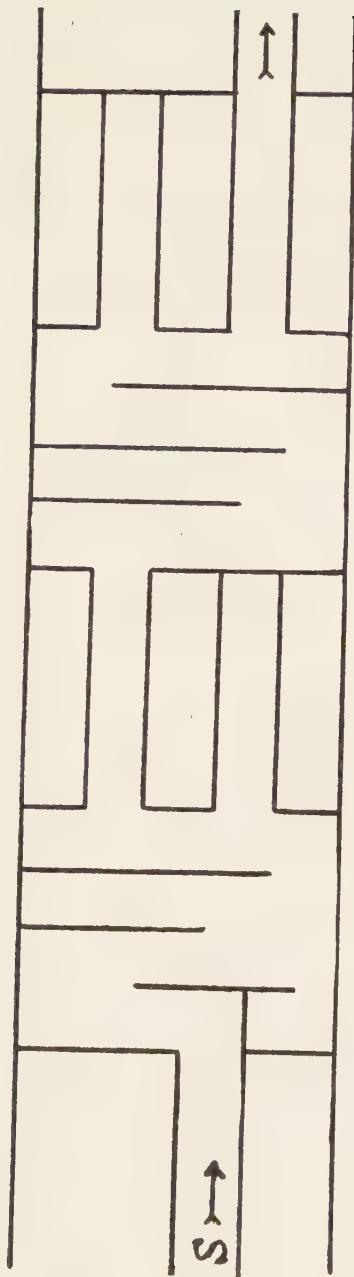
It should be mentioned that there are difficulties in the way of using the maze as test material for the higher age levels. The labyrinths can be made so complicated that a trial and error plan is as likely to bring success as one that is worked out by careful preconsideration. When this is the case they cease to become tests and become puzzles. The author is not ready to assume that the adult tests examine the same traits as the tests in the original series do. At any rate, data for the interpretation of the adult tests have not yet been provided in the same way as for the tests in the original series.





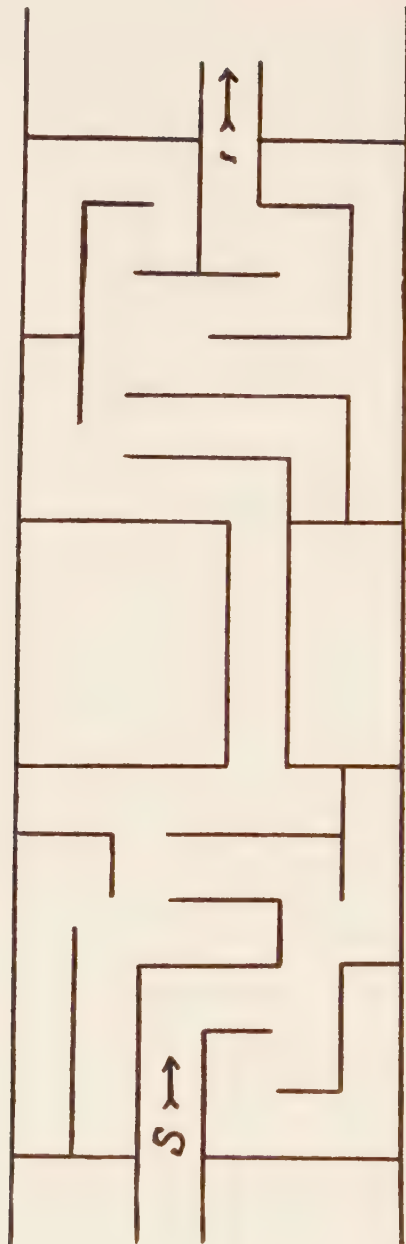


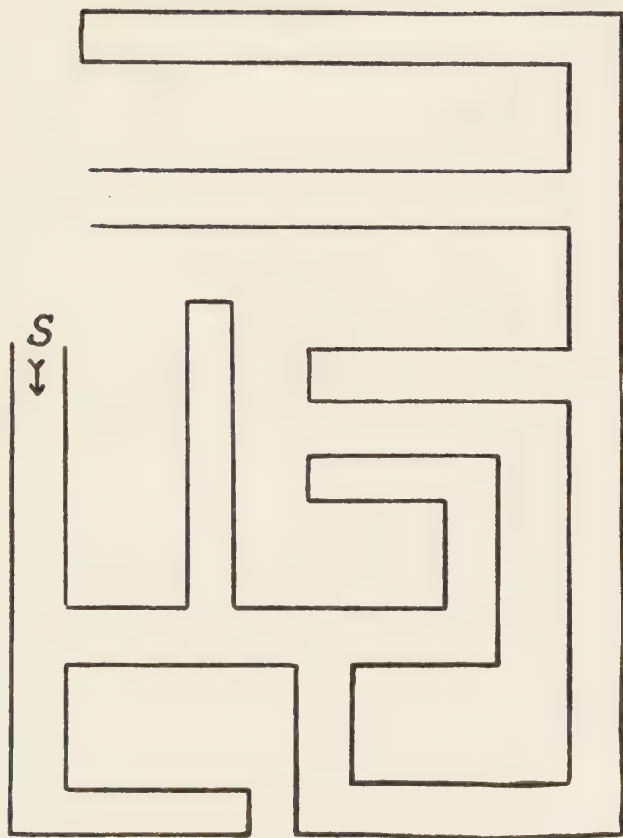


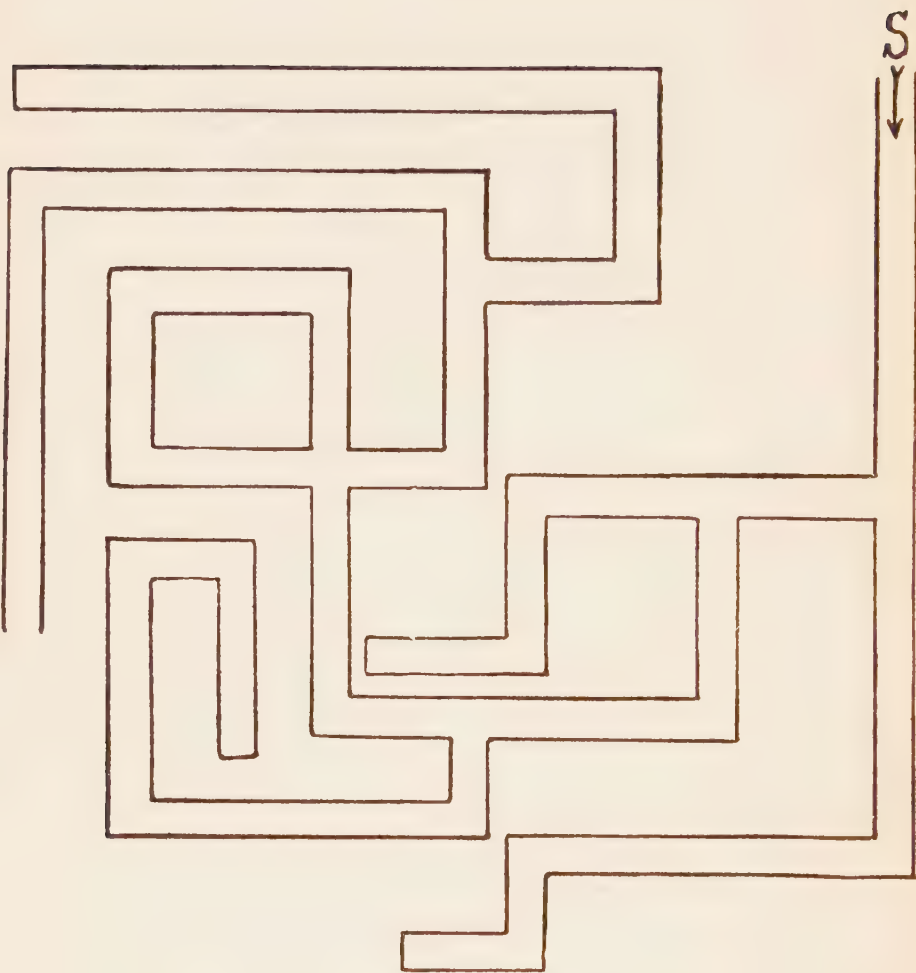


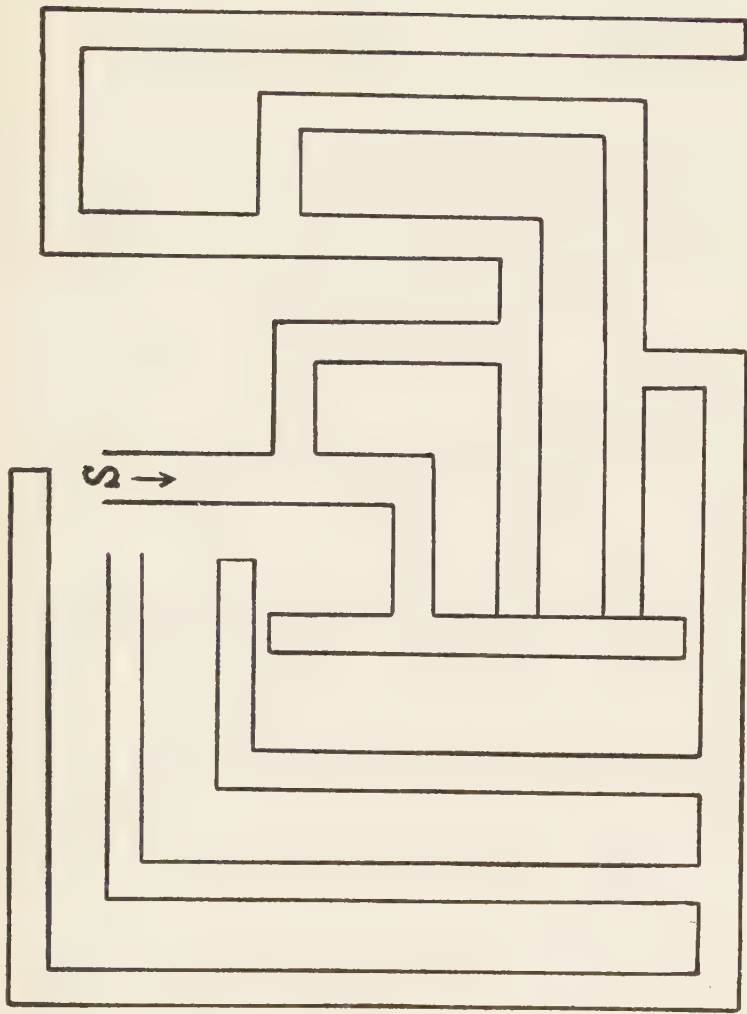
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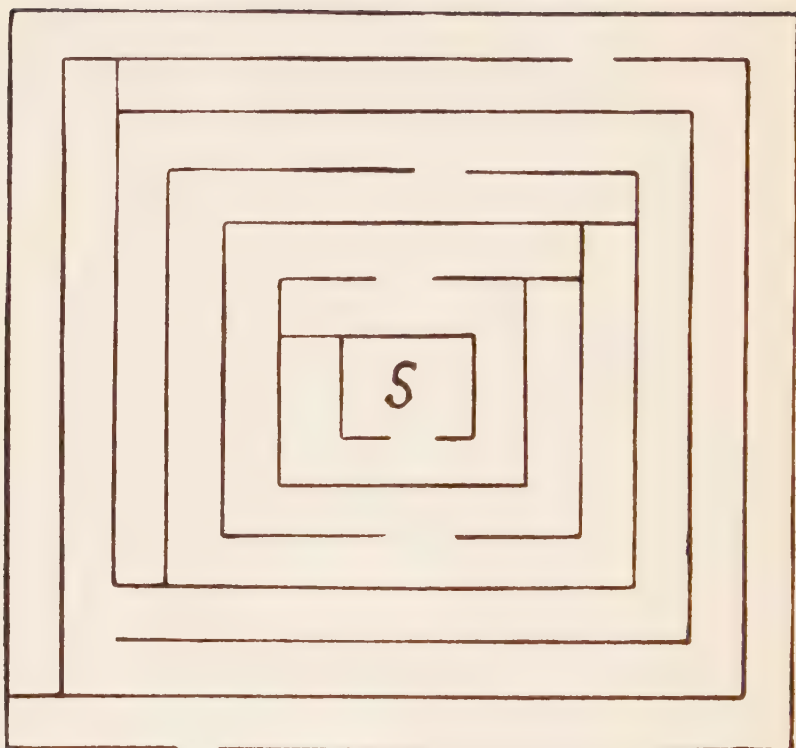
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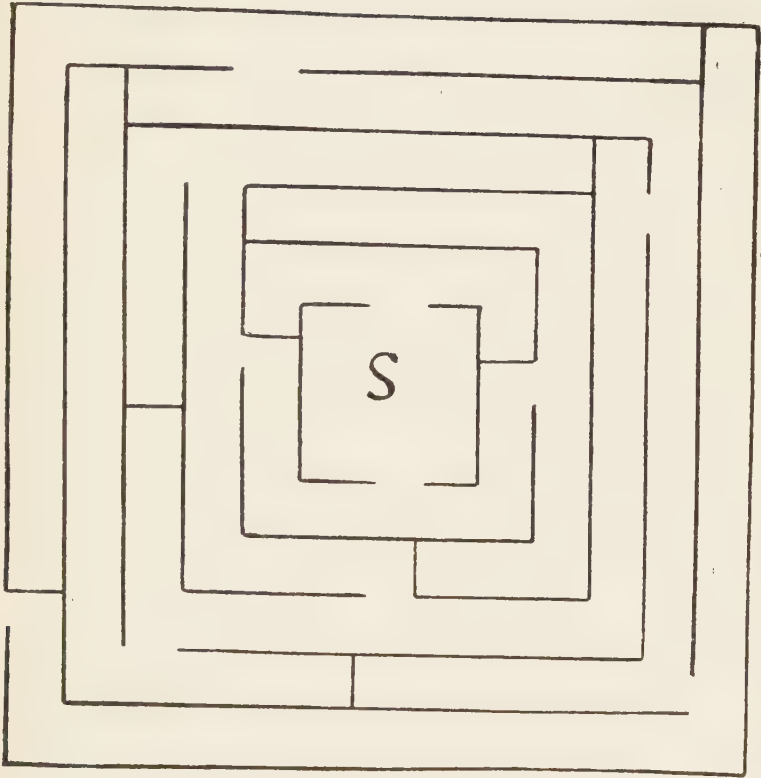


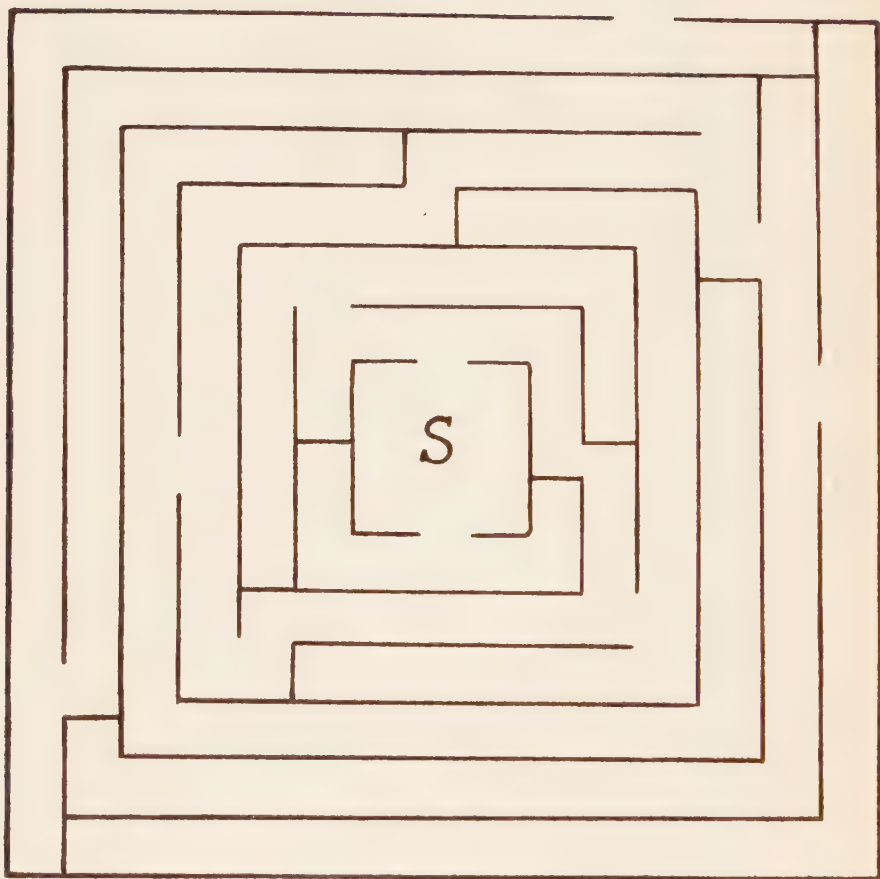


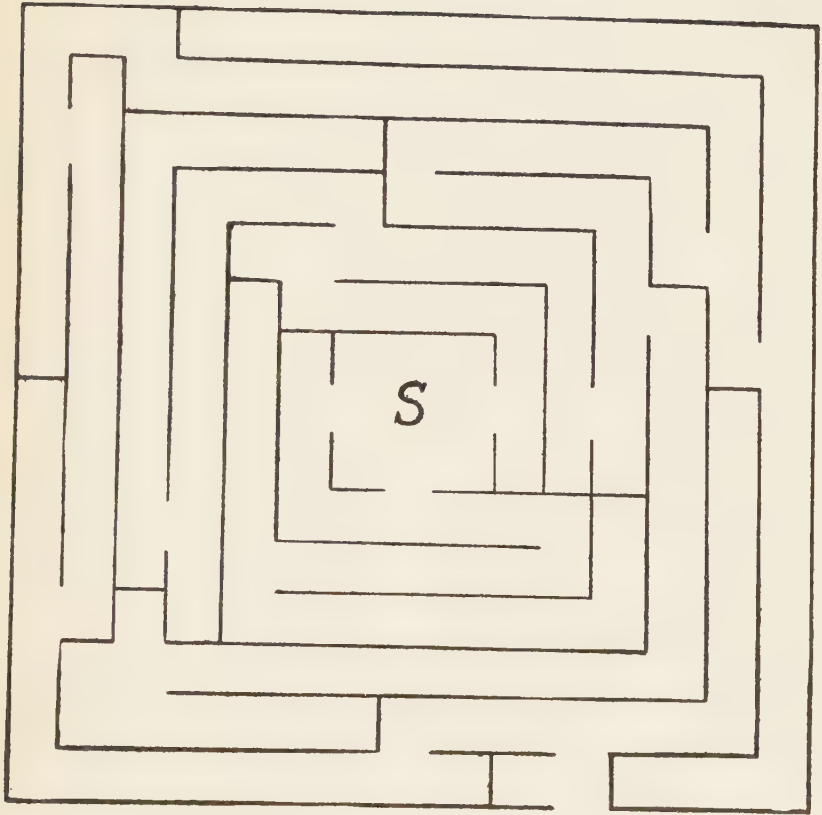


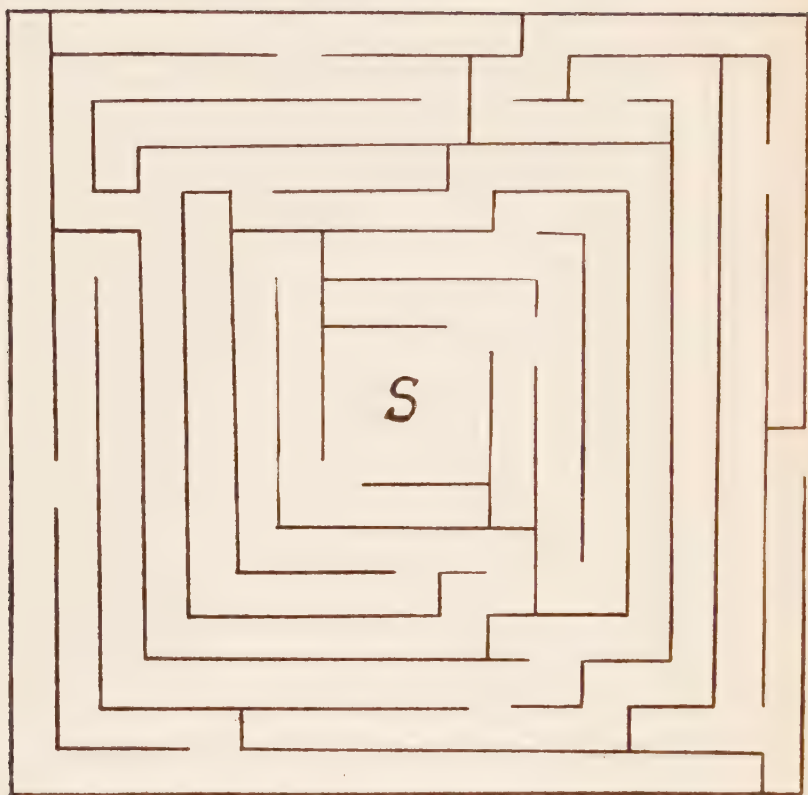














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